Concentration Dynamics of Fecal Indicators in Hawaiian Coastal and Inland Sand, Soil, and Water during Rainfall Events

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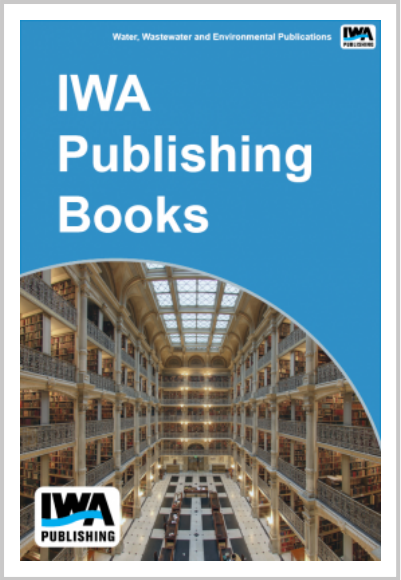

The contamination of recreational waters by waterborne pathogens poses a health threat to beach users. Recently, the importance of beach sand to the biological quality of beach water has been realized and verified. This study examined how urban rainfall runoff from a tributary stream affects the concentrations of fecal indicator bacteria (FIBs) in beach sand at a marine beach on the island of Oahu, Hawaii. Rainfall runoff was found to cause temporary increases in concentrations of enterococci and E. coli at Waialae-Kahala Beach, and beach foreshore sand and submerged sand were strongly influenced by beach water. High concentrations of enterococci and C. perfringens were consistently detected in beach submerged, foreshore, and backshore sands, indicating that beach sands may be important reservoirs of enterococci and C. perfringens. Additionally, the effects of rainfall runoff on FIBs in an inland freshwater stream were also investigated in the Manoa Stream watershed. Concentration spikes of FIBs always corresponded to rainfall runoff, and although the same rainfall runoff effects were observed for different land uses (i.e. forest versus urban), much higher concentrations of FIBs were detected in the urban reaches than in the forest reach of Manoa Stream. Furthermore, large numbers of FIBs were detected persistently in Manoa Stream bank soil. Urban and forest land uses, however, did not affect soil FIB concentrations. The concentrations of the traditional FIBs (i.e. enterococci and E. coli) correlated with prior cumulative rainfall and soil moisture levels, supporting the possibility of growth of enterococci and E. coli in soil. qPCR quantification of enterococci was found to correlate with mEI agar plate counts in beach water, but not in beach sand and estuarial and freshwater samples from streams, which indicates that the presence of naked DNAs, VBNC cells, and PCR inhibitory compounds can have a significant impact on qPCR outcomes.

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